

**International Conference «Physical Protection of Nuclear Material and
Nuclear Facilities»**

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Systematic aspects of high effective physical protection systems design for Russian nuclear sites

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OUTLINE

- **Legal and regulatory documents in area of Physical Protection (PP)**
- **Physical Protection System (PPS) as complex man-machine system**
- **Systematic approach to PPS designing**
- **PPS lifecycle**
- **Practical results**

PHYSICAL PROTECTION DOCUMENTS

INTERNATIONAL (IAEA)

- **Convention on the Physical Protection of Nuclear Material, INFCIRC/274/rev.1, 1980 (as amended on 7/07/2005, put into force on 08/05/2016).**
- **Physical Protection of Nuclear Materials (NM) and Nuclear Facilities (NF) – INFCIRC/225/rev.5, 2011.**
- **IAEA Guidelines on Nuclear Security (NºNº 1-26).**
 - ✓ **12 Fundamental Principles (A-L)**

NATIONAL

Wide Range of Physical Protection Laws and Regulations at Federal, Agency, and Site Level

PHYSICAL PROTECTION LEGISLATION. FEDERAL LEVEL (1)

Federal Law “On the use of atomic energy”, approved by Russian Federation Parliament (Duma) on 20 October, 1995

Chapter XI. Physical Protection (PP) of Nuclear Power Plants (NPP), Radiation Sources, Storages of Nuclear Material (NM) and Radioactive Substance (*Articles 49,50,51,52*)

Statement 50. *Requirements for Nuclear Materials, Nuclear Facilities and Nuclear Sources Physical Protection*

“Nuclear Facilities usage is prohibited...,if Physical Protection Measures are not undertaken”

PHYSICAL PROTECTION LEGISLATION. FEDERAL LEVEL (2)

Federal Laws related to Physical Protection (examples)

- **“On Security”**
- **“On Terrorist Acts Countermeasures”**
- **“On Agency Guards”**
- **“On Transportation Security”**
- **“On State Secrets”**
- **Others**

PHYSICAL PROTECTION REGULATIONS. FEDERAL LEVEL (1)

General Rules on Physical Protection of Nuclear Material, Nuclear Facilities and Nuclear Material Storages, authorized by Government of the Russian Federation # 456 on July 19, 2007:

- **General**
- **Federal Physical Protection System**
- **Organization and Implementation of Physical Protection**
- **Basic requirements for NM physical protection during transportation**
- **Physical Protection Monitoring: federal, state, agency and site level**
- **Notification about unauthorized acts**
- **NM categorization**
- **Categorization of unauthorized acts consequences**

PHYSICAL PROTECTION REGULATIONS. AGENCY LEVEL

- **General requirements for PPS and its elements**
- **Regulations for cooperation of all organizations involved in PP activity**
- **Regulations for management of PPS agency monitoring**
- **Regulations for management of PPS design, commissioning and operation**
- **Methodology of vulnerability analysis and PPS effectiveness evaluation**
- **Other**

PPS LEVELS

- **State physical protection system**
- **Facility physical protection system**
- **Physical protection of nuclear material in transport**

PPS ON SITE

Combination of physical protection personnel providing administrative and technical measures, and technical security systems

PPS – COMPLEX MAN-MACHINE SYSTEM

- **Large number of different elements (physical protection equipment, physical barriers, response forces)**
- **Uncertainty of threats, insiders and outsiders possible actions**
- **Stochastic nature of PPS operations (environment, seasons etc)**
- **Human factor**

SYSTEMATIC APPROACH TO PPS DESIGN AND EVALUATION (1)

- **Review of PPS as a whole system**
- **Implement a quantitative methods for PPS effectiveness evaluation**
- **Searching of PPS “weak points” and development of organizational and technical measures to eliminate them**
- **PPS optimization on a base of “cost-effectiveness” criteria**

SYSTEMATIC APPROACH TO PPS DESIGN AND EVALUATION (2)

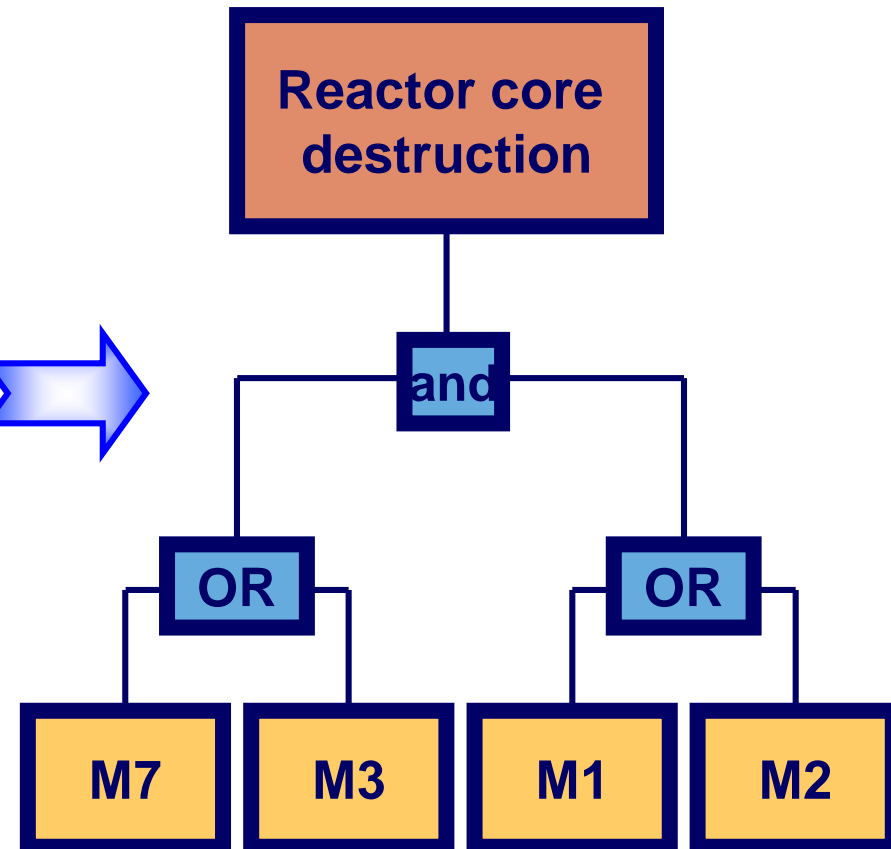
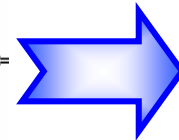
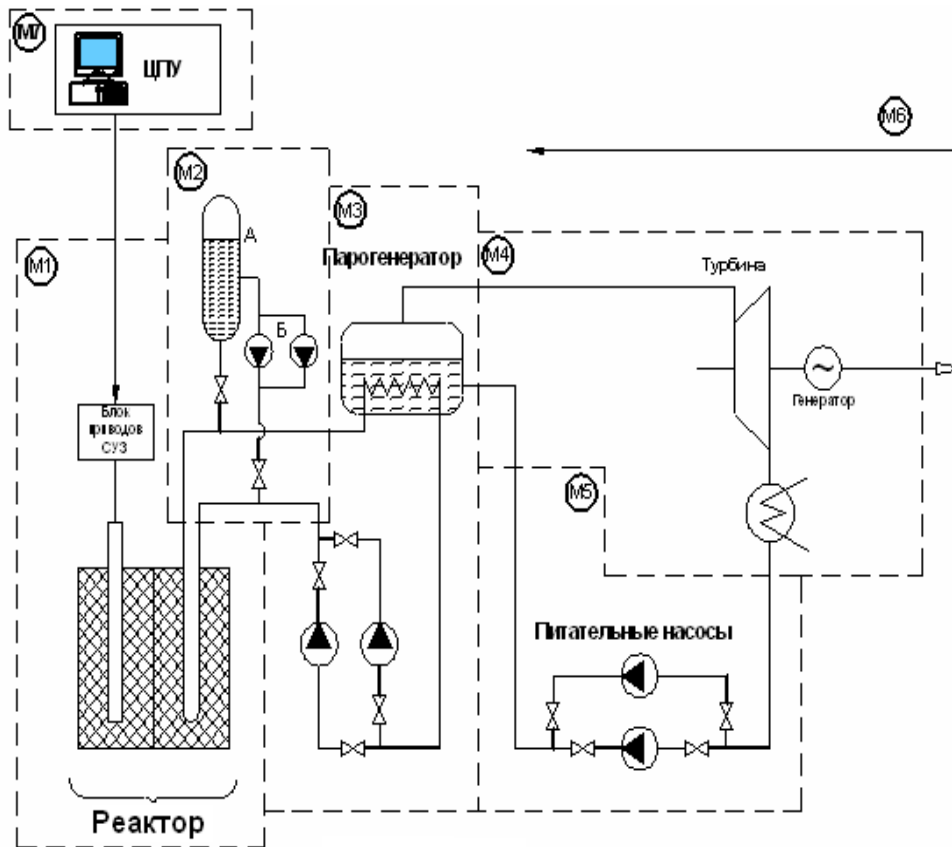
- **Given consideration for PPS as a complex man-machine system**
- **Analysis and usage of interrelations of PPS and correlated safety/security systems (examples):**

Safety	Vulnerability analysis, Target identification and DBT determination
NMAC	Interrelated procedures, data exchange
Radiation Protection	Joint usage of equipment (radiation monitors etc)
Information Security	PPS data confidentiality
Fire Protection (FP)	PPS shall take into account FP requirements

PPS DESIGN BASIC PRINCIPLES

- **Physical Protection Adequacy to Design Basis Threat (DBT)**
- **Protection-in-depth**
- **Timely Response to Accepted Threats**
- **Adaptability**
- **Balanced protection**
- **Permanent Monitoring of PPS status**
- **General Technical Principles**

TARGET IDENTIFICATION (EXAMPLE)



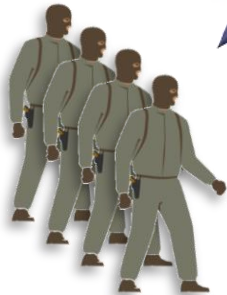
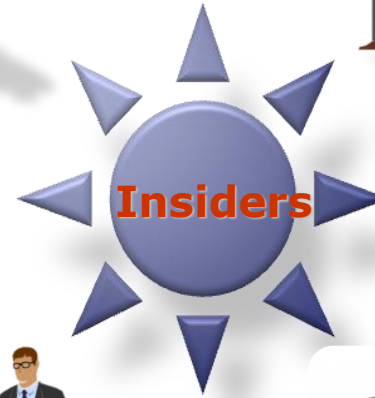
ADVERSARY CLASSIFICATION

«Kamikaze»

Individual Intruder

Visitor

Support Personnel



Force group
(big)

Force group
(small)

Basic Staff

Guards

DESIGN BASIS THREAT (DBT)

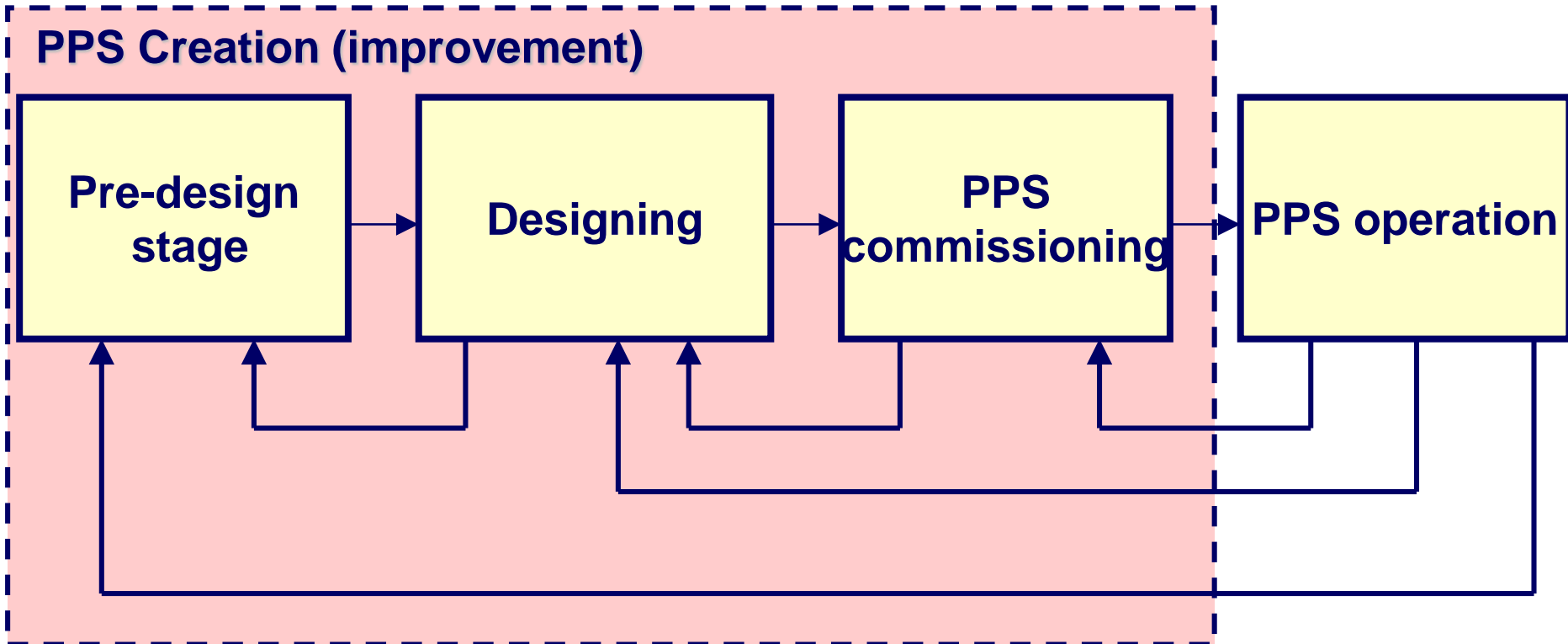
State Level

- **Design Basis Threat (DBT) document is available, approved by Russian Federation Government**

Facility Level

- **Detailed DBT documents are available for all Russian Nuclear Sites to take into account their features**

PPS LYFECYCLE



PPS DESIGN (IMPROVEMENT) PRE-DESIGN STAGE

- **Vulnerability assessment of facility** – searching for items has to be protected – target identification and design basis threat (DBT) determination
- **PPS effectiveness evaluation** – quantitative assessment of mentioned protection targets and a whole nuclear site protection level
- **PPS conceptual designing** – future PPS “profile” determination and characteristics assessment of suggested versions

ASSESSMENT OF PPS EFFECTIVENESS

Regulatory Base

ROSATOM document "Physical protection systems for nuclear sites. The guidelines for the effectiveness assessment" (2015)

Tools

Computer programs "Vega-2", "Polygon"
(ROSATOM, "Eleron")

Practice

The PPS effectiveness assessment has been performed for all most important ROSATOM sites

COMPUTER PROGRAM "VEGA-2" (1)

Application Area

Evaluation of PPS effectiveness (probability of site physical protection) under given PPS structure and accepted threats and adversary profiles

Main features

- Effectiveness assessment automation
- Accounting of a random character of the processes in system "guard-adversary"
- Guard force tactics consideration (stations, alarm group)
- Possibility of consideration of actions of insiders and outsiders
- Low-level user qualification requirements

COMPUTER PROGRAM VEGA-2 (2)

Certificates



Practice

“Vega-2” computer program implemented at plenty Russian Nuclear Sites

COMPUTER PROGRAM "POLYGON" (1)

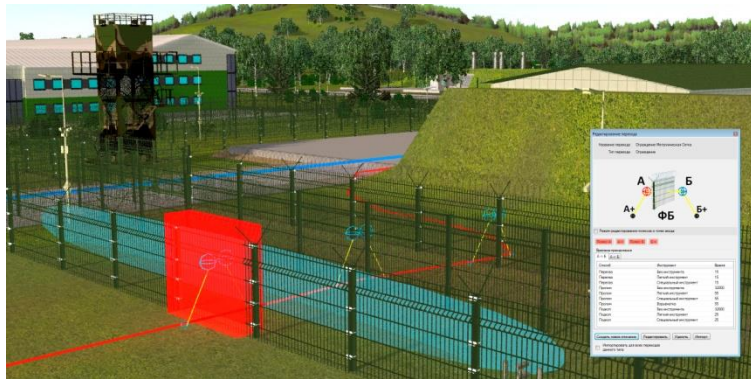
Application Area

Simulation of local combats in system "guard-adversary" on transport vehicles

Main features

- Application of a probability model of firing from different types of weapons considering shooters skills and target characteristics
- Automation of definition of intervisibility and a possibility of people and vehicles movement
- Record-keeping to provide a battle retrospective view
- Terrain editor (3D)
- Open software architecture

COMPUTER PROGRAM "POLYGON" (2)



**Situations
(examples)**



Training

COMPUTER PROGRAM "POLYGON" (3)

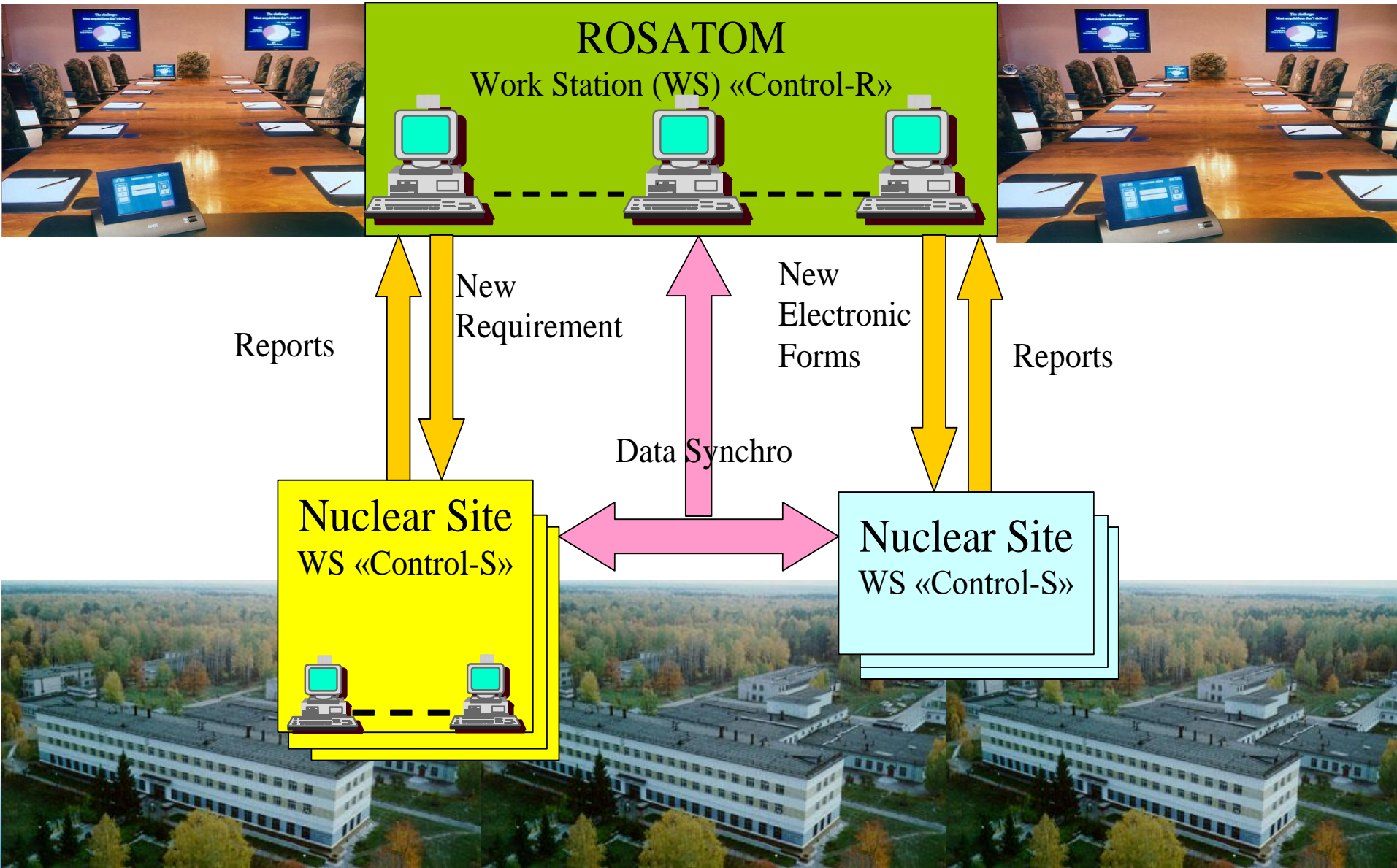
Certificates



Practice

“Polygon” computer program (transport version) developed by SNPO “Eleron” and implemented on military units and training centers

PPS MONITORING SYSTEM



SOME PRACTICAL RESULTS

- **Methodologies and tools of effectiveness evaluation are implemented at nearly all State Corporation “Rosatom” sites**
- **“Vega-2” computer program is certified and placed at more than 20 nuclear sites**
- **“Poligon” computer program placed for training purposes to 12 troop units that provides nuclear facilities protection**
- **“Control” System is successfully operates for PPS status data collection at all “Rosatom” sites**

CONCLUSION (1)

- **Russia possesses a wide spectrum of nuclear and radiation-hazardous facilities that require Physical Protection on mandatory basis**
- **Legal and regulatory framework in the area of Physical Protection of Nuclear Materials and Nuclear Facilities has been developed**
- **PPS lifecycle stages and milestones have been reviewed**
- **Special attention is paid to the PPS pre-design stage where main conceptual decisions are made. PPS effectiveness evaluation methods and tools were developed and put into practice**

CONCLUSION (2)

- **PPS systematic analysis is based on:**
 - ✓ **PPS Consideration as a complex man-machine system**
 - ✓ **Consideration of interrelations among PPS and related Safety and Security Systems (Safety, NMAC, Radiation Protection, Information Security, Fire Protection, etc)**
- **The entire spectrum of individual security components and integrated systems has been developed and implemented in Physical Protection Systems at Russian nuclear facilities**
- **A lot of attention is paid to the education and professional development of Physical Protection experts**
- **Russian experts actively participate in IAEA activities (AdSec, NSGC, INSEN, training courses, regulations development)**

**Thank you for your
attention!**